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P4.097 Design of the JT-60SA cryogenic pipe system

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JT-60SA is a tokamak device using superconducting coils to be built in Japan, as a joint international research and development project involving Japan and Europe. One design object of JT-60SA is maximization of the plasma volume and the instrumentation port availability in the condition that several buildings, heating instruments, and diagnostics of JT-60U are reused. The cryogenic pipe system of JT-60SA, which transfers cold helium from the helium refrigerator to cold components such as superconducting coils, thermal shield and diverter cryopumps, has two unique features due to the limited space mentioned above.
One of them is a complicated path. Relatively small 11 valve boxes and 5 coil terminal boxes are separately installed around the tokamak cryostat asymmetrically, instead of a simple large distribution box and a current feeder box.
The other is that several inlets to superconducting coils are placed on upper side of coils, which makes difficult requests for structural analyses because of the higher part of coils, the larger displacement due to the gravity load, the seismic load, vacuuming the cryostat, cooling down the cold components, and the electro-magnetic force by the plasma operation. For example, the cryogenic pipe interface of JT-60SA Toroidal Field Coil is displaced about 8 mm, 11mm and 38 mm toward radius, toroidal, and vertical direction.
In order to determine the design, structural analyses are conducted using ANSYS® software, which is a finite element analysis tool. The analysis result must satisfy that the stress for all pipes and their support structures are lower than the allowable stress of the material and there is no physical interference with any other components as a result of displacement. In this work, the strategy of analysis and the design for JT-60SA cryogenic pipe system are reported.

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